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A Comparative Study on the Impact of Verb Implicit Causality on Inter-clausal Anaphoric Bias in Chinese and English

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Abstract

Verb implicit causality is a semantic feature that influences language processing, such as pronoun resolution and sentence generation, by implicitly suggesting the potential focus of an event's cause. Previous studies demonstrate that in inter-clausal anaphora resolution, the bias of verb implicit causality toward either NP1 or NP2 (in "NP1 Verb NP2" structure) affect the selection of antecedent. From a comparative linguistic perspective, this study employs a corpus-based approach, collecting linguistic data for 150 Chinese verbs through sentence completion experiments, in order to compare the features of verb implicit causality in Chinese and English. A database of Chinese verbs is constructed with variables including semantic categories, emotional overtones of verbs, and gender effects. It follows by a quantitative analysis of Chinese and a comparison between Chinese and English. The findings indicate that Chinese verb implicit causality exhibits an overall bias for NP2 in inter-clausal anaphora resolution, aligning with the trend observed for English. However, the strength of NP2 preference in Chinese is significantly higher than that in English. Furthermore, semantic category, emotion of verbs, and gender also show significant effects, with certain cross-linguistic correlations observed between Chinese and English. This study advances the research on verb implicit causality by providing a viable methodological framework and a dataset containing factors from a comparative Chinese-English perspective.

Keywords: Verb implicit causality, Anaphora resolution, Corpus-based approach, Chinese-English comparison

1. Introduction

Anaphora resolution has long been a central topic in both natural language processing and psycholinguistics, as it plays a crucial role in maintaining discourse coherence. Coherence relies heavily on referential prominence, and studies have shown that pronouns tend to refer to the most salient entity in a discourse. One influential factor in determining this prominence is implicit causality, which can affect how antecedents are interpreted and guide the assignment of referents (Gundel et al., 1993). Implicit causality has been widely studied across different languages, with research indicating that implicit causality influences both language comprehension and production (Rudolph & Försterling, 1997). Additionally, cognitive and sociocultural research has revealed cross-linguistic variations in how different languages encode causal structures (Hartshorne et al., 2013).

The relationship between this verb-driven biases and inter-clausal anaphora resolution remains an open question, especially in typologically distinct languages like Chinese and English. For instance, it is still unclear to what extent verb biases impact the interpretation of pronouns in these languages, given their differing syntactic and semantic structures.

Therefore, this study aims to conduct a comparative analysis of the impact of verb implicit causality on inter-clausal anaphoric bias in Chinese and English. By examining how verb biases influence pronoun resolution across these languages, this research seeks to contribute to the broader understanding of linguistic and cognitive factors involved in anaphora resolution. The findings will provide insights into linguistics differences in referential processing and offer valuable resources for computational models of language comprehension. Additionally, this study will address the gap in large-scale corpus-based research on implicit causality in Chinese, providing normative data for future studies in psycholinguistics and computational linguistics.

2. Implicit Causality

Understanding natural language involves not only interpreting the literal meaning of words but also recognizing the causal relationships embedded within events. Causality can be explicitly expressed through conjunctions such as *because* and *due to*, which directly signal the cause-effect link. This type of causality is referred to as explicit causality. However, causality can also be conveyed more subtly, without direct mention, leaving it to the listener to infer the causal connection from the context. This form of causality is called implicit causality.

Implicit causality is a semantic property of verbs that implies a causal relationship between the entities involved in the event. Specifically, it suggests that one of the participants (either the subject or the object) is likely to be perceived as the cause of the event. For instance, in the sentence *Jane admires Mary*, the verb admires might implicitly suggest that *Mary* is the likely cause of *Jane*’s admiration. This bias enhances the prominence of *Mary*, which in turn affects the resolution of pronouns and sentence completion in subsequent clauses. In the next clause, *Mary* is more likely to be identified as the antecedent of the pronoun, and if a causal explanation follows, *Mary* is more likely to be positioned as the subject of the explanation.

The concept of implicit causality was first introduced by Heider (1958), who proposed that attribution can be triggered by transitive verbs. Garvey and Caramazza (1974) empirically supported this hypothesis by conducting a series of sentence completion experiments. They introduced the term *implicit causality* to describe how verbs influence causal attribution. Their study focused on interpersonal verbs linking two animate entities, with one entity being implicitly highlighted as the cause of the event. Based on these attribution tendencies, they classified verbs into three categories: those that attribute causality to the subject (NP1-biased verbs), those that attribute causality to the object (NP2-biased verbs), and those that show no clear preference, known as neutral verbs.

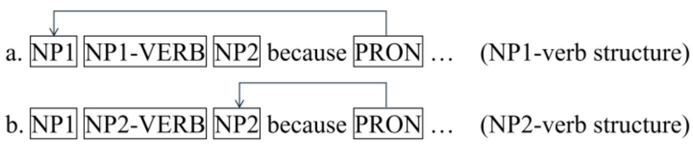

Figure 1. Anaphoric Bias of Verbs

2.1 Taxonomies of Verbs

To explain the underlying causes of attribution preferences, several studies have explored the relationship between verb semantics and causal attribution. Heider (1958) initially classified verbs into two broad categories: action verbs and state verbs, suggesting that action verbs are typically associated with NP1-biased verbs, while state verbs tend to be associated with

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NP2-biased verbs. However, this broad classification failed to fully account for the observed differences in causality attribution. To refine this classification, Brown and Fish (1983) introduced the idea of considering thematic roles within verbs. They argued that causality is more likely to be attributed to the Agent in action verbs, and to the Stimulus in state verbs.

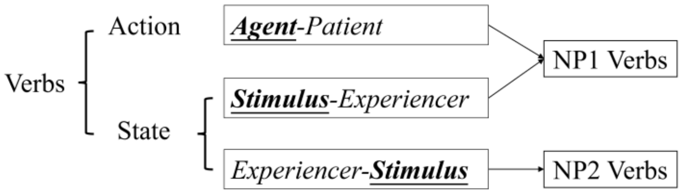

Figure 2. Brown & Fish's classification

Building on this framework, Rudolph and Försterling (1997) proposed the *Revised Action-State Taxonomy* to categorize implicit causality verbs into four more specific categories: *Agent-Patient, Agent-Evocator, Experiencer-Stimulus,* and *Stimulus-Experiencer*. This classification aimed to better capture the complex ways in which causality is attributed in different verb types. For instance, action verbs typically attribute causality to the Agent, whereas state verbs attribute causality to the Stimulus, though the syntactic position of the Stimulus can vary. This refined taxonomy provides a more nuanced understanding of how verbs shape causal attribution and is widely adopted in current research on implicit causality.

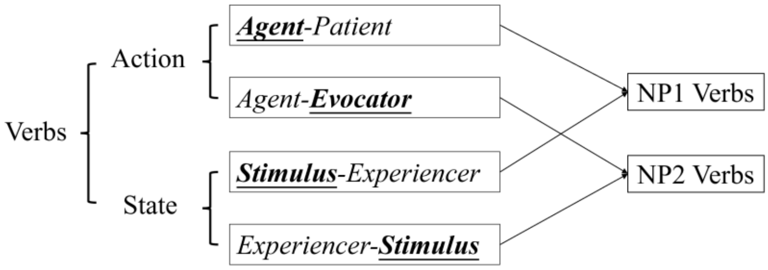

Figure 3. Revised Action-State Taxonomy

2.2 Corpus-based Research on Verb Implicit Causality

A significant contribution to the study of implicit causality is the development of large-scale corpus-based research, which provides empirical data on how different verbs influence causal attribution across languages. One pivotal study is that of Ferstl et al. (2011), which established a normative dataset of implicit causality biases for 305 English interpersonal verbs. The aim was to provide reliable data for psycholinguistic studies and social psychological research. In their study, participants completed sentence fragments such as *John liked Mary because…*, thereby determining the causality attribution. The verbs were classified into four categories based on the revised action-state taxonomy. Additionally, factors such as verb frequency, emotional valence, and gender effects were considered. The study found that semantic categories, emotional valence, and gender effects all played a role in the attribution of causality. This research underscores the significance of implicit causality in shaping discourse coherence, as verb biases influence not only the interpretation of pronouns but also sentence processing.

They also made the corpus publicly available, thus providing a valuable resource for future studies. This large-scale dataset has facilitated comparative studies of implicit causality across languages. For example, Ngo and Kaiser (2020) extended the methodology by collecting implicit causality data for 149 Vietnamese verbs. Their comparative analysis between Vietnamese and English verbs revealed interesting linguistic differences, e.g. English verbs showed a stronger preference for NP1, while Vietnamese verbs demonstrated a more balanced distribution.

The development of large-scale verb corpora has significantly advanced research on implicit causality, enabling the quantitative comparison of biases across languages. However, a major limitation remains: many languages, like Chinese, still lack comprehensive datasets of implicit causality verbs. This scarcity hinders our understanding of both cross-linguistic commonalities and the unique manifestations of implicit causality in different languages.

Therefore, this study aims to combine existing survey methods with the unique linguistic characteristics of Chinese to construct a large-scale database of implicit causality verbs. By quantitatively analyzing the features of these verbs, this research will attempt to answer several key questions:

1) Does verb implicit causality influence anaphora bias in Chinese? What are the factors associated with this bias?

2) What are the similarities and differences between implicit causality in Chinese and English verbs?

Beyond the scope of this study, the resulting corpus will serve as a publicly accessible normative resource, contributing to the broader field of linguistic research on implicit causality.

3. Method

3.1 Materials

The Chinese verbs used in this study were drawn from two primary sources. First, they were the Chinese equivalents of 119 English verbs selected from the corpus compiled by Ferstl et al. (2011), which remains the largest publicly available database of verb implicit causality to date. This corpus is based on extensive linguistic data and provides detailed parameters for each verb, making it particularly well-suited for comparisons.

Second, since many commonly used Chinese verbs are not covered in the English corpus due to language differences, we supplemented our selection with 31 disyllabic verbs from Zhang's (2019) study on implicit consequentiality verbs in Chinese. These additional verbs were carefully chosen to avoid semantic overlap with the existing set, resulting in a final selection of 150 Chinese verbs.

3.2 Questionnaire Design

The questionnaire design was based on the sentence completion method employed in previous studies (e.g., Garvey et al., 1974; Zhang, 2019). In the questionnaire, participants were presented with a main clause followed by a conjunction and were asked to complete the subordinate clause based on their own understanding and interpretation. For example:

Xiao Ming	*taoyan*	*Xiao Hong,*	*yinwei*	_____________.
Xiao Ming	hates	Xiao Hong,	because	_____________.

'Xiao Ming hates Xiao Hong, because________________.'

Participants were expected to begin the subordinate clause with either the subject or the object of the main clause, or the plural pronoun *tamen* ('they').

Previous studies have adopted three approaches to gender pairing: (1) same-gender pairs for both NP1 and NP2 (e.g., Brown & Fish, 1983); (2) opposite-gender pairs (e.g., Au, 1986); and (3) mixed-gender pairs. This study follows the third approach, incorporating four gender pairings: *Female-Male, Male-Female, Female-Female*, and *Male-Male*. While same-gender pairings intuitively control for gender as a variable, allowing implicit causality bias to manifest without extralinguistic interference, previous empirical studies have shown that gender indeed influences anaphora bias (Ferstl et al., 2011). Therefore, both same-gender and opposite-gender pairings were included to ensure a more comprehensive analysis.

For name selection, we utilized the large language model *Kimi* (moonshot-v1-20240416) to generate common disyllabic Chinese names. Gender ambiguity was to be avoided, ensuring that each name aligned with conventional gender connotations in the Chinese sociocultural context. After screening the generated names, 30 male and 30 female names were selected for this study.

A total of 150 verbs were tested, each paired with four gender settings, resulting in 600 experimental sentences. These sentences were evenly distributed across 25 questionnaire versions, with each version containing 24 sentences. To minimize contextual interference, no verb and name appeared more than once within the same questionnaire.

For compound-structure verbs (e.g., *xiang... daoqian* 'apologize to'), the prepositional phrase was appropriately segmented and recombined to ensure grammatical correctness. For example:

Xiao Ming	*xiang*	*Xiao Hong*	*daoqian.*
Xiao Ming	to	Xiao Hong	apologize.

'Xiao Ming apologized to Xiao Hong.'

The phrase *xiang...daoqian* ('apologize to') was segmented into *xiang* (preposition) and *daoqian* (verb), with the NP2 name inserted in between.

3.3 Participants

The questionnaire participants were undergraduate and postgraduate students from Huazhong Agricultural University, all of whom were native Chinese speakers. A total of 99 individuals took part in the survey, including 47 males and 52 females. The majority of participants (96.97%) were between 18 and 30 years old. Regarding educational background, 94.96% held a bachelor's degree or higher.

3.4 Corpus Building

After distributing the questionnaire and collecting the responses, a total of 2,376 sentences were obtained. A quality control and data filtering process was subsequently conducted to ensure the validity of the dataset. To minimize the potential influence of researchers' subjective bias on the experimental results, a set of objective screening criteria was established. Sentences meeting any of the following conditions were deemed invalid:

(1) The sentence was incomplete or lacked semantic coherence;

(2) The content was evidently unrelated to the given context;

(3) An extraneous entity irrelevant to the described event was introduced;

(4) The sentence incorporated internet memes, jargon, or personal anecdotes, making it difficult to comprehend for uninformed readers;

(5) Multiple consecutive responses within the same questionnaire exhibited repetitive content or artificial connections between unrelated events.

Three native Chinese speakers participated in the filtering process. Following the initial screening, all sentences identified as invalid were re-examined, and ambiguous cases were discussed before reaching a final decision. As a result, 2,170 sentences were retained, yielding a data validity rate of 91.33%.

Then, annotation was conducted on the refined dataset. Each sentence was tagged with relevant information, including the corresponding verb, questionnaire version, gender pair, anaphora type, and gender of reference.

Based on the annotated dataset, a database comprising 150 verbs was constructed. Each verb entry contained four key variables: *Bias Score, Semantic Category, Emotion*, and *Gender Effect Score*. Among them, Bias Score was the primary focus of this study, as it quantified the overall anaphoric tendencies observed in the dataset.

The Bias Score quantifies the extent to which a verb exhibits a preference for NP1 in anaphora resolution. The calculation method follows Ferstl et al. (2011) and is defined by the following formula:

$$Bias\ Score = \frac{(NP1 - NP2)}{(NP1 + NP2)} \tag{1}$$

In this formula, NP1 Count represents the number of instances where NP1 was selected as the antecedent, while NP2 Count represents the number of instances where NP2 was chosen. The Bias Score ranges from -1 to 1:

- Values closer to 1 indicate a stronger bias toward NP1.
- Values closer to -1 indicate a stronger bias toward NP2.
- Values near 0 suggest neutrality, with no significant preference for either referent.

The Gender Effect Score measures the impact of gender on anaphoric bias in mixed-gender pairs. The formula is as follows:

$$Gender\ Effect\ Score = \frac{(mNP1-mNP2)}{(mNP1+mNP2)} - \frac{(fNP1-fNP2)}{(fNP1+fNP2)} \tag{2}$$

In this formula, "m" refers to sentences with a male subject, and "f" refers to sentences with a female subject. The Gender Effect Score is calculated by taking the difference between the bias scores of sentences with male subjects and those with female subjects. The score ranges from -2 to 2:

- Higher values indicate a stronger influence of male on bias.
- Lower values indicate a stronger influence of female on bias.
- Values near 0 suggest that gender does not significantly impact anaphoric bias.

For the comparative analysis, this study adopts a factorial design as shown in Table 1. The selected verbs are categorized into four semantic categories, with each category containing a balanced distribution of emotional valence (positive, negative, and neutral verbs in a 5:5:2 ratio). This ensures consistency between the two languages in terms of semantic classification and emotional distribution, thus minimizing potential sample distribution differences that could affect the experimental results. The factorial design also allows us to investigate the effects of various factors on implicit causality at different levels.

Table 1. Factorial Design

Independent Variable			**Dependent Variable**
Language	Semantic Category	Emotion	
Chinese English	AgPat AgEvo ExpStim StimExp	Positive Negative Neutral	Bias Score

3.5 Data Analysis

Data analysis was conducted using SPSS, with Python employed for data visualization. First, basic descriptive statistical analyses were performed. Subsequently, the effects of three factors—semantic category, emotion of verbs, and gender—on anaphoric bias were examined to assess their statistical significance. A similar approach was applied to the Chinese-English comparison, focusing on identifying correlations and differences in verb implicit causality between the two languages.

4. Results

4.1 Analysis of Chinese Verbs

First, we analyzed the overall distribution of bias scores for Chinese verbs and observed a noticeable negative tendency (M = -0.286, Med = -0.333, SD = 0.533), as illustrated in Figure 4. According to the bias score formula (1), lower values indicate a stronger tendency for a verb to assign NP2 as the causal referent in inter-clausal anaphora. This suggests that, in general, implicit causality in Chinese verbs exhibits a preference for NP2.

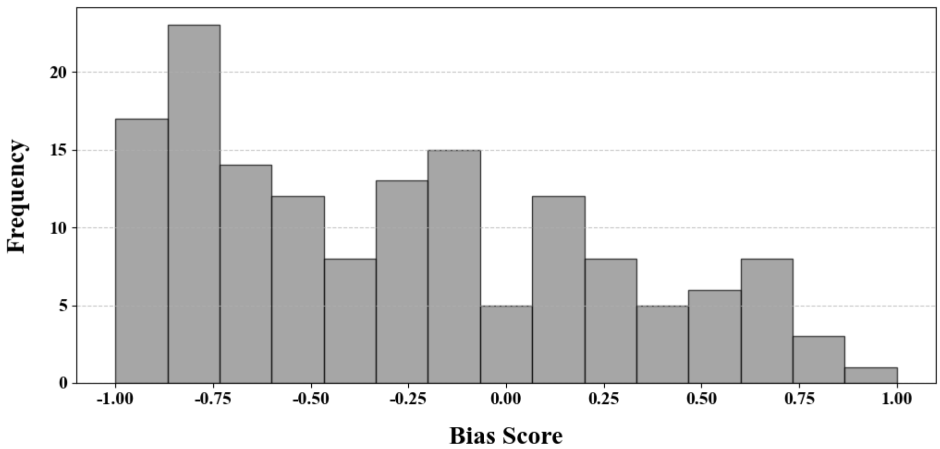

Figure 4. Histogram of Bias Scores of Chinese Verbs

To confirm the statistical significance of the NP2 preference, we employed the Wilcoxon signed-rank test, which assesses whether the population median of bias scores significantly differs from 0 (i.e., whether an NP2 bias exists). The results showed a significant negative tendency ($Z = -5.813$, $p < 0.001$), confirming that, overall, Chinese verbs exhibit a preference for NP2 as the antecedent in inter-clausal anaphora resolution.

Next, to assess the impact of semantic category on anaphoric bias, we analyzed the mean bias scores across different categories (Figure 5).

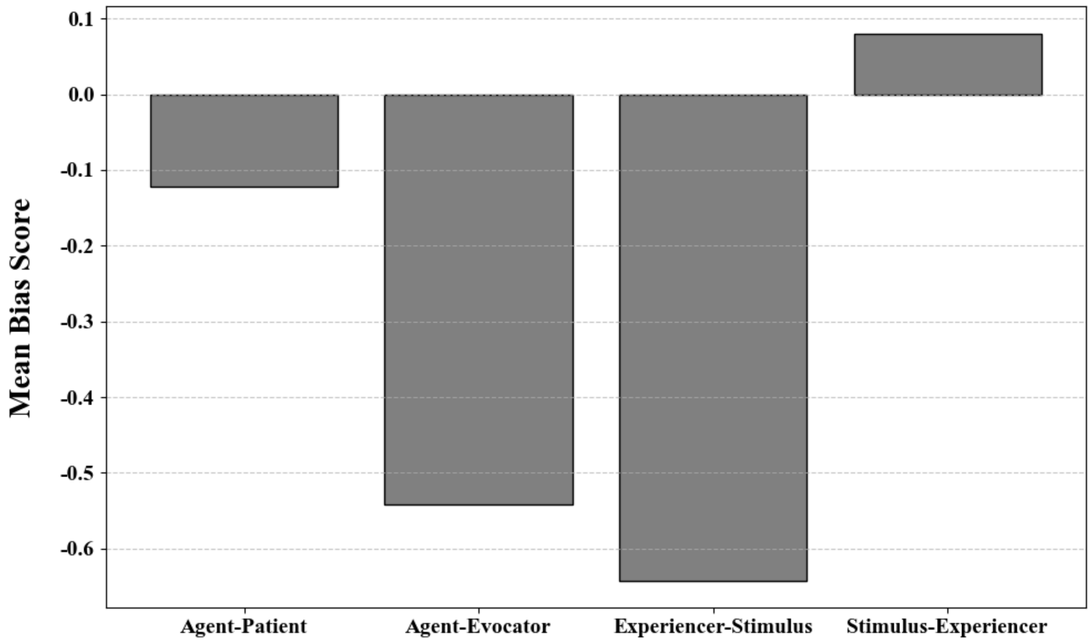

Figure 5. Mean Bias Scores in Semantic Categories

To assess the statistical significance of bias, we conducted Wilcoxon signed-rank tests to determine whether the median bias scores of each semantic category significantly deviated from 0. The results showed that AgPat (M = -0.122, SD = 0.459, Z = -2.076, p = 0.038), AgEvo (M = -0.542, SD = 0.486, Z = -3.992, p < 0.001), and ExpStim (M = -0.642, SD = 0.356, Z = -4.946, p < 0.001) all had medians significantly lower than 0, indicating a statistically significant NP2 bias. In contrast, StimExp did not show a significant deviation from 0 (M = -0.080, SD = 0.534, Z = -0.973, p = 0.330), suggesting that verbs in this category do not inherently influence anaphora preferences. These findings are consistent with the overall NP2 bias observed previously, with StimExp as an exception, indicating that verbs in this category do not significantly influence anaphora resolution. To further investigate potential differences across categories, we conducted a Kruskal-Wallis H test, and the results confirmed a statistically significant difference among semantic categories (p < 0.001), suggesting that while AgPat, AgEvo, and ExpStim all favored NP2, the strength of this tendency varied.

We then investigated the influence of verb emotion on anaphoric resolution. As shown in Figure 6, the mean bias scores for all emotional categories were negative. The Wilcoxon signed-rank test revealed that the median bias scores of positive verbs (M = -0.440, SD = 0.516, Z = -4.719, p < 0.001) and negative verbs (M = -0.208, SD = 0.537, Z = -3.001, p = 0.003) were significantly lower than 0. In contrast, neutral verbs did not exhibit this pattern (M = -0.193, SD = 0.516, Z = -1.857, p = 0.063). These results suggest that both positively and negatively valenced verbs in Chinese tend to display a notable NP2 preference, whereas verbs with neutral emotional valence do not demonstrate a specific bias. To assess whether emotion had a statistically significant impact on anaphoric bias, we conducted a Kruskal-Wallis H test. The results indicated significant differences in bias scores across the three emotional categories, although the effect of verb emotion on anaphora was weaker compared to that of semantic category ($p < 0.05$).

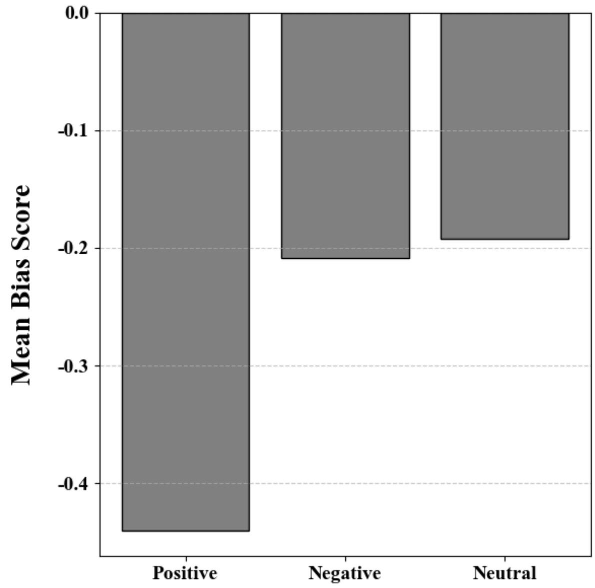

Figure 6. Mean Bias Scores of Emotional Tendencies of Verbs

Furthermore, we examined whether the effect of emotion varied across different semantic categories. Overall, positively valenced verbs exhibited a stronger NP2 bias, while the inherent bias of a given semantic category influenced the strength of the negativity effect. Notably, neutral verbs demonstrated a significant preference only within the ExpStim category. The Kruskal-Wallis H test results showed no significant differences in bias scores among emotional categories within AgPat, ExpStim, and StimExp ($p = 0.458$, $p = 0.538$, and $p = 0.384$, respectively). However, AgEvo verbs were found to be significantly affected by emotion ($p = 0.026$). As illustrated in Figure 7, both positive and negative AgEvo verbs exhibited a strong NP2 bias, whereas neutral AgEvo verbs did not follow this trend. The Wilcoxon signed-rank test further confirmed that the anaphoric bias of neutral AgEvo verbs was statistically insignificant ($p = 0.893$).

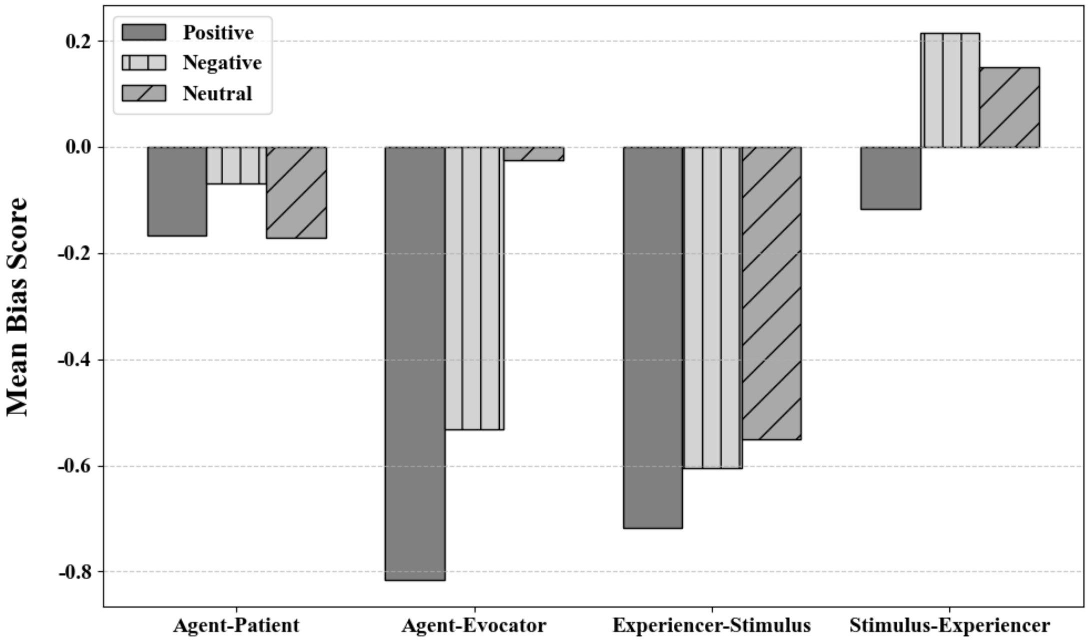

Figure 7. Mean Bias Scores of Emotions within Each Semantic Category

Next, we examined the impact of gender on anaphoric bias. Descriptive statistics suggest that implicit causality in Chinese verbs is more strongly influenced by males overall ($M = 0.254$, $SD = 0.575$). This observation is further supported by the Wilcoxon signed-rank test ($Z = 2.906$, $p = 0.004$), indicating that, in events involving two individuals of opposite genders, males are more likely to be assigned as the cause. We further analyzed the bias scores in Female-Male and Male-Female gender pairs. In both cases, the mean values aligned with the overall NP2 bias observed earlier. However, the strength of the bias varied between the two pairs. As shown in Figure 8, in sentences where the subject is female and the object is male, the NP2 bias is stronger ($M = -0.342$, $SD = 0.645$, $Z = -5.758$, $p < 0.001$). In contrast, when the subject is male and the object is female, the NP2 bias is relatively weaker ($M = -0.177$, $SD = 0.712$, $Z = -2.921$, $p = 0.003$). The Wilcoxon signed-rank test confirms the significance of this difference ($p = 0.004$).

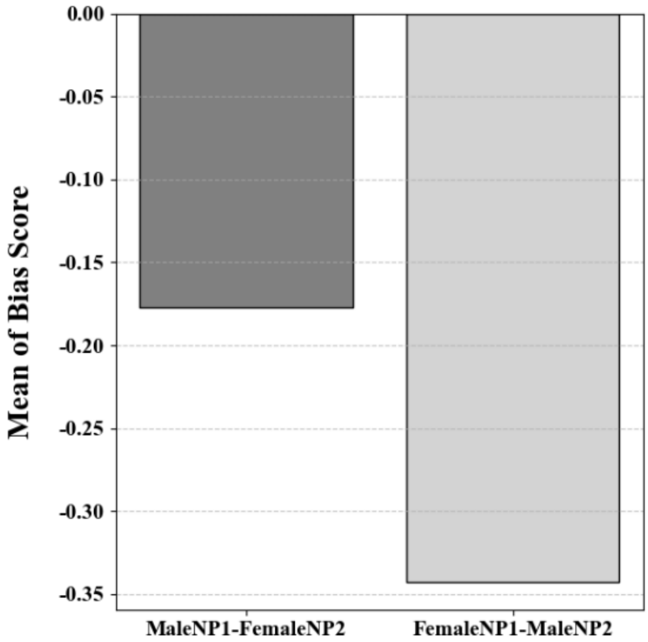

Figure 8. Mean Bias Scores of Gender Pairs

Finally, we applied a Generalized Linear Model (GLM) to analyze the interactions between the variables mentioned above. The results revealed no significant interactive effects between semantic category and emotion ($p = 0.126$), semantic category and gender ($p = 0.617$), or emotion and gender ($p = 0.637$).

4.2 Chinese-English Comparison

In this study, we collected and analyzed corpus data exclusively for Chinese, as Ferstl et al. (2011) have already provided a detailed description and in-depth analysis of implicit causality in English verbs. Due to space limitations and differences of the scope in the verb selection, we will not replicate their findings in this paper. Instead, we selected 95 verbs from the English corpus for a Chinese-English comparison, based on the factorial design. The complete corpus from their study is available in the Psychonomic Society Archive.

First, we compare the overall bias patterns in Chinese and English, as shown in Table 2 below.

Table 2. Descriptive Statistical Values of Bias Scores

	Chinese	English
M	-0.367	-0.175
Med	-0.529	-0.260
SD	0.544	0.581
Skew	0.761	0.376
Kurt	-0.450	-1.155

In selected samples, both Chinese and English exhibit negative mean and median bias scores. Wilcoxon signed-rank tests confirm that the median bias scores are significantly lower than 0 in both languages (Chinese: $Z = -5.433$, $p < 0.001$; English: $Z = -2.836$, $p = 0.005$), indicating an overall NP2 preference. Notably, the mean and median bias scores in Chinese are lower than those in English, while the skewness and kurtosis values are higher. This suggests that the distribution of bias scores in Chinese is more concentrated below 0, reflecting a stronger NP2 preference. Additionally, we conducted a correlation analysis to examine the relationship between anaphoric biases in the two languages. The results of Spearman's rank correlation test indicate a strong positive correlation between anaphoric biases in Chinese and English verbs ($\rho = 0.71$, $p < 0.001$), suggesting a high degree of similarity in preference patterns across the two languages.

Next, we examined how different variables influence anaphoric bias in both languages. Beginning with semantic categories, the mean bias scores for each category in Chinese and English are presented in Figure 9.

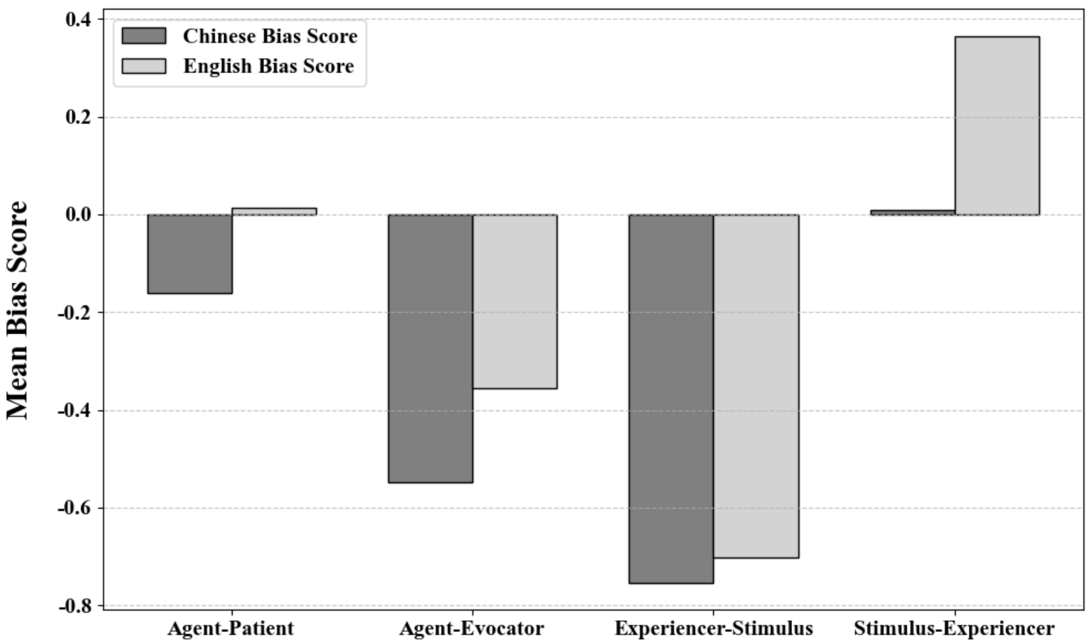

Figure 9. Comparison of Semantic Categories

Despite numerical and directional differences, notable cross-linguistic similarities emerge, given that both Chinese and English verbs exhibit an overall NP2 bias. Specifically, AgEvo and ExpStim verbs demonstrate a significantly strong NP2 bias in both languages ($p < 0.001$), with ExpStim verbs displaying a stronger NP2 preference than AgEvo verbs. In contrast, AgPat and StimExp verbs exhibit a greater tendency toward NP1 preference. Moreover, when comparing mean bias scores, Chinese AgPat and StimExp verbs show lower values than their English counterparts, suggesting a stronger NP2 preference in Chinese.

We further analyzed each semantic category in detail. AgPat verbs in Chinese and English exhibited a positive correlation ($\rho = 0.494$, $p = 0.014$). Additionally, the median bias scores in both languages did not significantly differ from 0 (Chinese: $Z = -1.722$, $p = 0.085$; English: Z

= 0.186, p = 0.853), indicating that AgPat verbs in our sample did not exhibit a strong anaphoric bias. The scatter plot in Figure 10 further illustrates this, with AgPat verbs evenly distributed around 0 on both axes. AgEvo verbs showed a stronger positive correlation between Chinese and English ($\rho = 0.591$, $p = 0.002$). The scatter plot revealed a clustering of values toward the lower end of both axes, reinforcing this correlation. Among all categories, ExpStim verbs exhibited the most similar mean values between the two languages and showed the strongest correlation ($\rho = 0.659$, $p < 0.001$). The scatter plot demonstrated a concentration of data points in the lower-left quadrant, with over half falling below -0.8 on the y-axis and ranging from -1 to -0.3 on the x-axis. This pattern suggests that while both languages strongly favor NP2 for ExpStim verbs, the bias is generally more pronounced in Chinese. For StimExp verbs, no significant correlation was found between Chinese and English ($\rho = 0.344$, $p = 0.108$), consistent with our analysis of mean values. In our sample, Chinese StimExp verbs did not exhibit a significant anaphoric bias ($Z = 0.213$, $p = 0.831$), whereas English StimExp verbs displayed a clear NP1 preference ($Z = 2.857$, $p = 0.004$). The scatter plot further highlights these differences: while data points were primarily concentrated on the right half of the x-axis, their distribution on the y-axis was more balanced between positive and negative values. This suggests notable cross-linguistic differences in both the direction and strength of anaphoric bias for StimExp verbs.

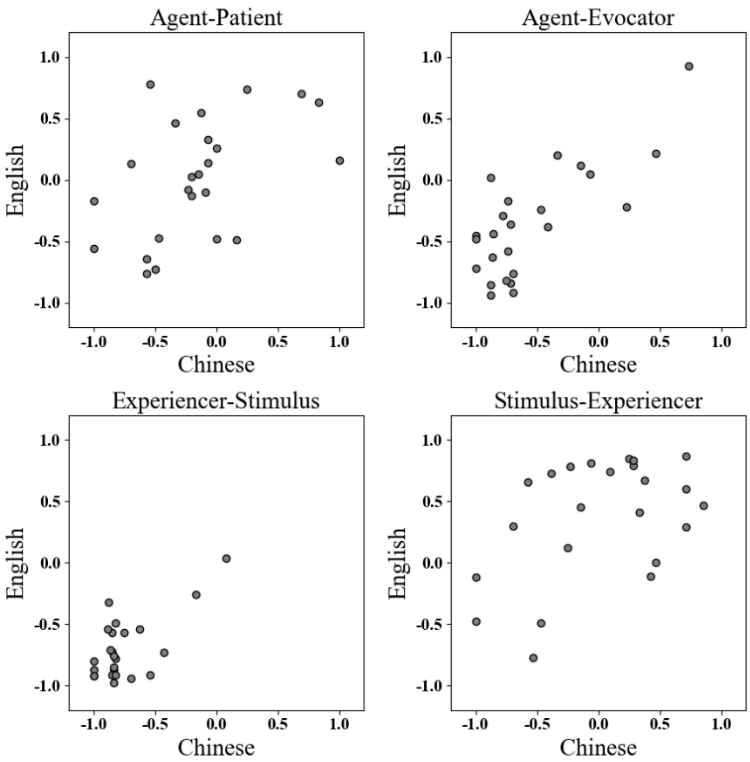

Figure 10. Scatter Plot of Semantic Categories

Next, we examined the effect of emotion in both languages.

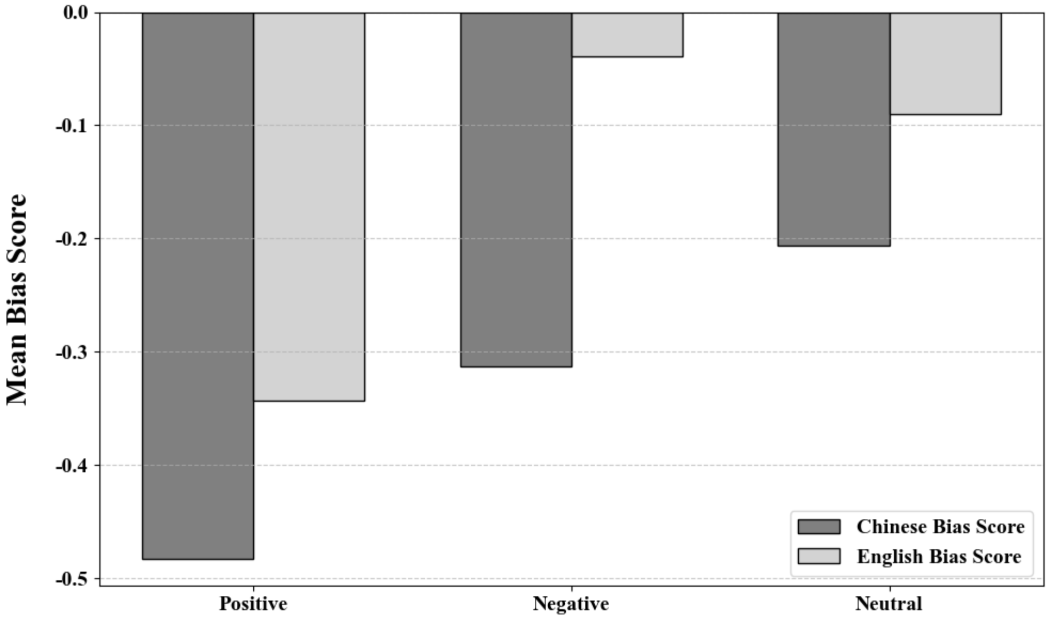

Figure 11. Comparison of Emotions

As shown in Fig. 11, positive verbs exhibited the strongest NP2 bias in both English and Chinese, with a significant correlation between the two languages ($\rho = 0.607$, $p < 0.001$). In terms of mean values, negative verbs in Chinese demonstrated the second-strongest NP2 preference after positive verbs. However, in English, negative verbs had a bias score closer to zero ($Z = -0.450$, $p = 0.652$). Despite this difference, negative verbs in Chinese and English showed a strong correlation in bias tendencies ($\rho = 0.735$, $p < 0.001$), suggesting that while English negative verbs followed the same overall trend as Chinese, a greater proportion exhibited an NP1 preference. For neutral verbs, both languages displayed an overall NP2 bias in terms of mean values. However, statistical tests indicated that neither language showed a significant preference (Chinese: $Z = -1.256$, $p = 0.209$; English: $Z = -0.824$, $p = 0.410$). Notably, neutral verbs exhibited the highest cross-linguistic correlation ($\rho = 0.764$, $p < 0.001$), suggesting that verbs with neutral emotion in both languages aligned closely in their lack of a strong anaphoric bias.

When examining the interaction between emotion and semantic categories in Fig. 12, we observed that AgEvo and ExpStim verbs exhibited similar emotional interaction patterns in both languages. While AgPat and StimExp verbs showed differences in mean values, their overall bias tendencies remained inconclusive. The only notable exception was negative StimExp verbs in English, which demonstrated a significant NP1 bias ($M = 0.578$, $SD = 0.216$, $Z = 2.803$, $p = 0.005$).

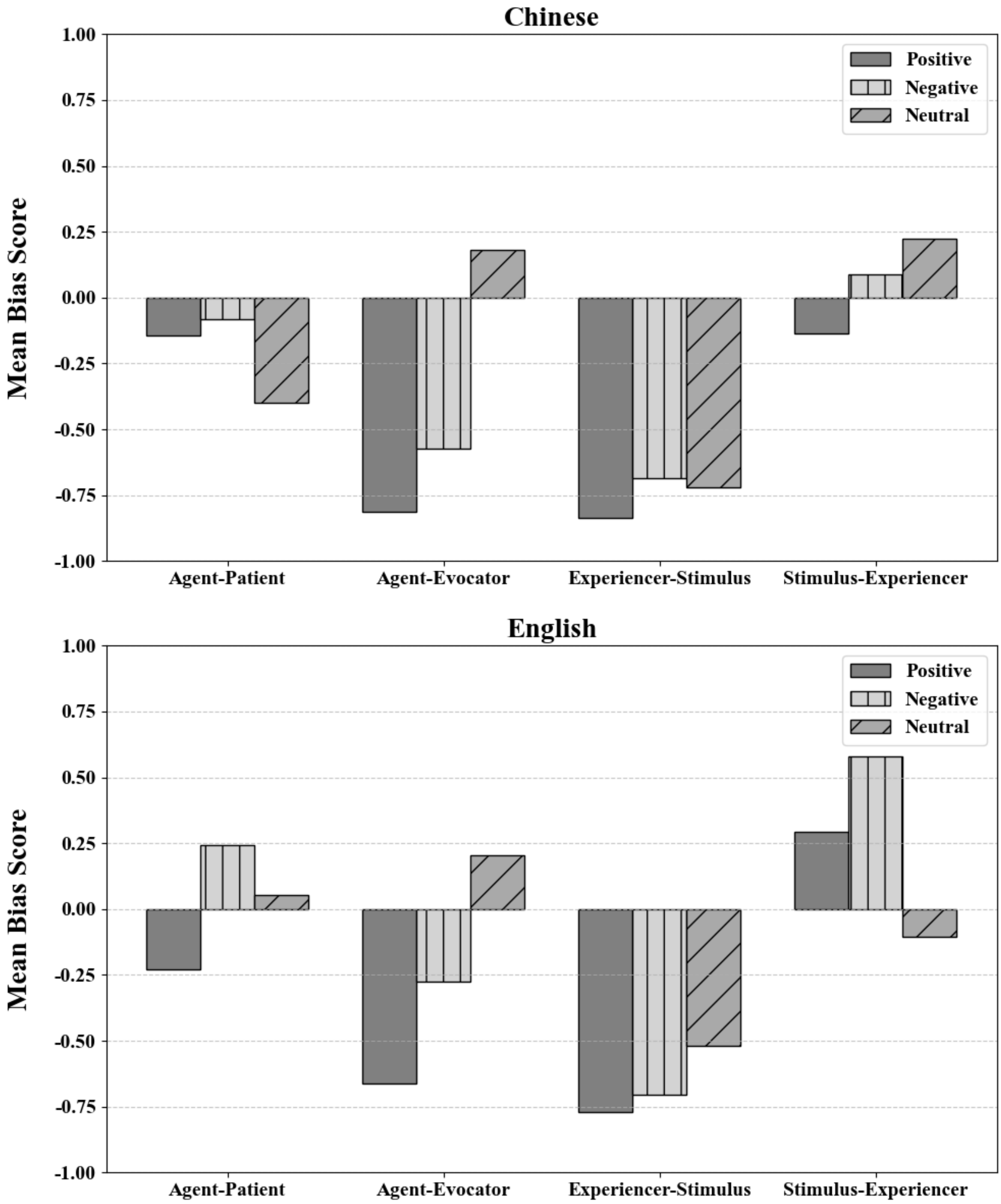

Figure 12. Comparison of Emotions within Each Semantic Category

Next, we examined the effect of gender on anaphoric bias. In terms of the mean gender effect score, anaphora resolution in Chinese was more influenced by male referents than in English (Chinese: M = 0.144, SD = 0.527; English: M = 0.043, SD = 0.204). However, Spearman correlation analysis revealed no significant correlation between the gender effect scores in Chinese and English (ρ = -0.056, p = 0.593), suggesting that while both languages exhibited a general tendency for male referents to exert a stronger influence on anaphora resolution, the magnitude of this effect varied. Additionally, the gender effect of individual verbs was not necessarily consistent across languages. We then analyzed anaphoric patterns across different gender pairs. A comparison of the mean bias scores for different gender pairs (Fig. 13) indicated that both Chinese and English exhibited a consistent pattern: sentences in which NP1 was female and NP2 was male showed a stronger NP2 bias than those in which NP1 was male and NP2 was female. In other words, the inherent NP2 bias in both languages was more pronounced when the NP2 referent was male. Notably, bias scores within the same gender pair were significantly correlated across the two languages (MaleNP1: $\rho = 0.500$, $p < 0.001$; FemaleNP1: $\rho = 0.556$, $p < 0.001$), further reinforcing the cross-linguistic consistency of this observation.

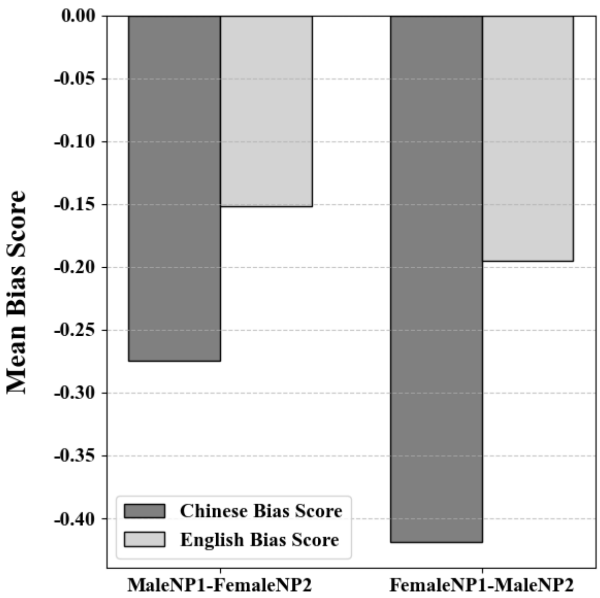

Figure 13. Comparison of Gender Pairs

Finally, no significant interactions were observed among semantic category, emotion, and gender in the English samples, aligning with the findings of Ferstl et al. (2011). This suggests that these three factors do not jointly influence inter-clausal anaphora through interaction but rather operate independently at different levels.

5. Discussion

This study complies a corpus of 150 Chinese verbs through a questionnaire-based experiment. The experimental design was informed by Ferstl et al.'s (2011) English corpus, from which 119 verbs that are semantically comparable to their Chinese counterparts were selected as the main subjects of study. Following Ferstl et al.'s (2011) analytic framework, three key factors were examined: semantic category, emotion and gender. Furthermore, we adopted their English corpus data for comparison.

5.1 Findings From the Analysis of Chinese Verbs

Our study is divided into two parts: an analysis of Chinese verbs and a cross-linguistic comparison of Chinese and English verbs. The findings on Chinese verb implicit causality are as follows:

First, the implicit causality of Chinese verbs has an overall influence on inter-clausal anaphora resolution. This aligns with previous studies on Chinese (e.g., Zhang, 2006) as well as research on other languages (e.g., Hartshorne et al., 2013). This further confirms that implicit causality, as a semantic feature, is a universal phenomenon. In Chinese, implicit causality is characterized by a significant NP2 bias, meaning that when a subordinate clause provides a causal explanation for the event described in the main clause, cognitive agents are more likely to attribute the cause to NP2 (i.e., the object). Descriptive statistics and non-parametric tests confirm the significance of this bias. This finding is consistent with earlier empirical studies using probe experiments (e.g., Bai et al., 2005), and our study further substantiates this conclusion through sentence completion experiments and corpus-based data analysis.

Second, the three factors—semantic category, emotion, and gender—are shown to affect the bias in anaphora resolution.

Regarding semantic category, AgPat, AgEvo, and ExpStim all demonstrate significant NP2 bias, while StimExp verbs show no clear preference. The NP2 bias is particularly strong in AgEvo and ExpStim verbs, while AgPat verbs are relatively more influenced by NP1 bias. Furthermore, the significance of the bias in these categories changes depending on the sample scope. For instance, in the subsequent comparison of 95 verbs, the NP2 bias in the Chinese AgPat category becomes insignificant, while AgEvo and ExpStim categories maintain a strong NP2 bias. Therefore, we conclude that the two semantic categories with the most significant influence on bias are AgEvo and ExpStim, with ExpStim having the stronger effect.

Next, we examine emotion: both positive and negative verbs exhibit significant NP2 bias, with positive verbs showing a notably stronger NP2 bias. In contrast, negative verbs are more influenced by NP1 bias. Neutral verbs, however, do not exhibit any significant bias in inter-clausal anaphora resolution, reflecting their neutral emotional nature. While this aligns with our expectations for neutral verbs, it remains a topic worth further investigation as to why, within the overall NP2 bias of Chinese verbs, neutral verbs maintain neutrality in their bias and are more strongly influenced by NP1 bias than negative verbs.

Finally, regarding gender: Our study investigates the influence of gender on anaphora resolution from two perspectives: the overall gender effect on individual verbs, and the bias exhibited by verbs in specific gender pairs. For the former, we use the gender effect score to represent the degree of gender influence. It is important to note that this score does not describe the specific direction or intensity of the anaphora but rather indicates which gender exerts a greater influence and to what extent. The analysis reveals that anaphora resolution in Chinese is more influenced by males. In other words, when making attributions, the male subject in the main clause is more likely to be seen as the target of attribution. Regarding the latter, we analyzed the anaphoric bias in Male-Female and Female-Male pairs. In the Female-Male pair, where the male is the object, the NP2 bias is stronger. In the Male-Female pair, where the male is the subject, the NP2 bias persists, but the preference is weakened compared to the previous case, showing some influence from NP1. This finding is consistent with the results from the gender effect score, which demonstrates that males are more likely to be seen as the object of attribution.

In summary, the factors of semantic category, emotion, and gender, which are commonly studied in English research, also apply to the study of implicit causality in Chinese verbs. These three variables influence and shape implicit causality at their respective levels, ultimately determining the specific anaphoric behavior of individual verbs.

5.2 Findings of Chinese-English Comparison

The comparison of verb implicit causality in Chinese and English is a key focus of this research. The following findings were obtained:

First, both Chinese and English verbs demonstrate an overall NP2 bias, and the bias patterns in the two languages are positively correlated. However, the NP2 bias in Chinese is significantly stronger. When the sample size is expanded to match the original scale of the English corpus, the overall NP2 preference remains consistent, suggesting that the influence of implicit causality on inter-clausal anaphora is relatively similar in both languages. Our analysis of Chinese, along with the comparison between Chinese and English, provides further typological evidence supporting the hypothesis that implicit causality in verbs generally favors NP2. Moreover, the correlation between the direction and strength of bias in the two languages further supports the cross-linguistic universality of implicit causality.

Second, the three factors—semantic category, emotion, and gender—show similar effects in both Chinese and English, despite slight differences.

For semantic category, AgEvo and ExpStim are the two categories with the strongest NP2 bias in both languages, with ExpStim generally showing a stronger bias than AgEvo. Furthermore, the bias patterns of these two categories are correlated across languages. This cross-linguistic observation further supports our hypothesis from the Chinese study that AgEvo and ExpStim exert the strongest influence on bias, with ExpStim having a greater effect. The main difference is that for both AgEvo and ExpStim, the NP2 bias is stronger in Chinese than in English. This aligns with the overall trend observed earlier, where Chinese verbs show a more noticeable NP2 bias.

In terms of emotion, positive verbs display the strongest NP2 bias in both languages, and this bias strength is positively correlated across them. Negatively valenced verbs also show an NP2 bias, but to a lesser extent than positive verbs, with negative verbs in English being more influenced by NP1 bias. Neutral verbs in both languages do not display a significant preference, and this neutrality is strongly correlated between the two languages. These findings suggest that the patterns of anaphora based on verb emotion are consistent across the two languages: positive verbs are least affected by NP1 bias, followed by negative verbs, while neutral verbs are influenced by both NP1 and NP2 biases, leading to an overall balanced effect with no clear preference. Additionally, we examined the interaction between semantic category and emotion, finding that the emotional distribution within AgEvo and ExpStim was highly similar in both languages. This provides further evidence that these two semantic categories exhibit the strongest anaphoric bias and share cross-linguistic commonalities.

The effect of gender also shows a degree of correlation between the two languages. The overall distribution of gender effect scores indicates that in both Chinese and English, when an event involves two opposite-gender participants, the male is more likely to be perceived as the attribution target. This gender effect is more prominent in Chinese, though this difference could be partially attributed to sample size variations. Further analysis of anaphora patterns in different gender pairings revealed a preference for male referents: in general, when verbs exhibit an NP2 bias, sentences where the male participant is the object show a higher frequency of NP2 anaphora compared to those where the female participant is the object. Although studies incorporating gender as a factor in implicit causality research are relatively rare, our comparative analysis confirms that gender is indeed a contributing factor in implicit causality and significantly influences anaphora resolution in mixed-gender contexts.

In summary, our findings suggest that implicit causality in Chinese and English verbs exhibits correlated patterns of anaphoric bias, with Chinese generally displaying a stronger NP2 bias than English. Furthermore, the three factors—semantic category, emotion, and gender—all play a role in both languages, and their effects are similar across the two. Notably, no significant interactions among these three variables were observed in either language, indicating that they independently influence anaphoric bias. Individual verbs are shaped by these properties, which ultimately manifest in specific anaphoric biases in actual language use.

5.3 Explanation of Results

Current research on verb implicit causality predominantly utilizes empirical methods to gain a more precise and comprehensive understanding of the phenomenon. However, explanations for its underlying causes and the fundamental nature of implicit causality remain theoretically underexplored. Based on our findings, we attempt to provide a tentative interpretation of the similarities between Chinese and English, as well as the factors that may account for their differences.

Both Chinese and English show an overall NP2 bias, which may be a natural consequence of how narratives unfold in discourse. When processing sentences containing two NPs, NP1 and NP2 are activated sequentially in the reader's brain. When the subordinate clause prompts the reader to establish causality for the event described in the main clause and select an antecedent, NP2—being the more recently activated entity—tends to have greater accessibility in short-term memory. As a result, selecting NP2 as the referent may be cognitively more efficient. Additionally, the spatial proximity between NP2 and the anaphor contributes to discourse coherence.

Despite this shared NP2 bias, Chinese exhibits a considerably stronger tendency toward NP2 than English. This difference can be explained by variations in subject preferences between the two languages. Previous studies have established that in subject-verb languages like English, linguistic processing like pronoun resolution often favors subjects as antecedents (Krebs et al., 2018). In contrast, whether Chinese demonstrates a similar subject preference remains a topic of debate (Lin & Bever, 2006). If we assume that Chinese lacks the subject preference observed in English, then the cross-linguistic differences in NP2 bias strength become more interpretable: discourse-level factors naturally favor NP2 over NP1. In English, the subject preference counteracts this tendency, leading to a weaker NP2 bias. In Chinese, the stronger tendency to associate anaphors with objects further amplifies the original NP2 bias, resulting in a more pronounced preference for NP2.

Beyond the overall bias pattern, the influence of semantic categories, emotion, and gender deserves further discussion. One notable issue is the ongoing debate surrounding the Revised Action-State Taxonomy, particularly the unclear boundaries between certain subcategories. For instance, the distinction between AgEvo and ExpStim is somewhat blurred, as both involve psychological meanings, and the event is triggered by the latter (Crinean & Garnham, 2006). Despite its limitations, this classification framework offers a potential explanation for our findings: both AgEvo and ExpStim verbs exhibit a strong NP2 bias, and their interactions with emotion follow highly similar patterns. The lack of a clear boundary between these two semantic categories may account for their shared characteristics in terms of implicit causality. Future research could refine semantic categorization—not by further subdividing the action/state dichotomy, but by identifying the deep-level shared features of these categories that contribute to implicit causality bias. Such an approach may lead to a more precise classification of implicit causality verbs.

In comparison to semantic categories, emotion and gender extend beyond the typical scope of theoretical linguistics, and no widely accepted explanations currently account for the complex effects of gender on language use. Our study confirms that both factors influence implicit causality and provides a general description of their impact patterns. Further exploration of these phenomena—whether through experiments or theoretical analysis—could be expected in future research within fields such as sociopsychology and psycholinguistics.

6. Conclusion

We employed a corpus-based approach, using a questionnaire survey to collect data from 99 participants based on 150 Chinese verbs. Through statistical analysis, we revealed the bias of verb implicit causality towards inter-clausal anaphora resolution and analyzed the effects of semantic categories, emotion, and gender on this preference. Our study shows that Chinese implicit causality verbs generally show a bias towards NP2 in anaphora, which aligns with the findings for English. However, the intensity of the NP2 bias in Chinese is significantly stronger across most aspects when compared to English. In both languages, AgEvo and ExpStim categories exhibit significant NP2 bias, and verbs with a positive emotional connotation show stronger NP2 bias. Moreover, when NP1 and NP2 are of opposite genders and NP2 is male, the NP2 bias is further enhanced. These results suggest that the phenomenon of implicit causality in verbs is similar across the two languages, with differences mainly in the strength of the bias. This provides further typological evidence for the universal nature of implicit causality and indicates that this feature is influenced by the unique characteristics of each language.

Although the correlation between our findings and previous research supports the reliability of our study, several areas for improvement remain. Our study focuses on a comparative analysis between Chinese and English, which led us to select a large number of verbs from the English corpus. However, many English verbs lack direct equivalents in Chinese or exhibit subtle semantic differences, potentially making linguistic comparisons less precise. Additionally, the high degree of lexicalization in Chinese makes word formation relatively more flexible, which allows for a larger inventory of verbs than in English. By limiting our study to verbs with approximate equivalents in the English corpus, we may not have fully captured the entire scope of verb implicit causality in Chinese. Furthermore, the frequently used vocabulary in Chinese and English differs significantly. To better reflect the characteristics of commonly used Chinese verbs, we supplemented the 119 verbs selected from the English corpus with 31 additional verbs drawn from previous Chinese studies. If the study were not constrained by the need for linguistic comparison, a broader range of verb selections could have been included. Nonetheless, our findings provide a foundation for future studies focusing more exclusively on Chinese.

Another important point to consider is that the framework based on the English corpus is not without limitations. For example, while semantic category, emotion, and gender have been shown to significantly influence implicit causality, there is little evidence of clear interactions among them. This suggests that additional factors beyond these three variables may modulate verb implicit causality. Moreover, while semantic category strictly falls within the domain of theoretical linguistics, the inclusion of emotion and gender introduces extralinguistic elements. These factors are shaped by sociocultural contexts, historical backgrounds, and gender norms, which can vary significantly within a linguistic community—particularly for a language like Chinese, which has a diverse user base. Conducting research on a specific group may introduce biases, making it challenging to develop a unified theoretical explanation for the observed phenomena. Nevertheless, these factors do show a significant influence on verb implicit causality. Therefore, we chose to include them in our study to better observe how implicit causality contributes to inter-clausal anaphora. However, unlike semantic categories, we did not delve deeply into the mechanisms behind the effects of emotion and gender. Instead, our findings offer a viable framework and useful data for future research, particularly in empirical studies within psychology, sociology, and their subdisciplines.

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Appendix A

Table A1. Questionnaire Sample

Index	Question
Q1	小薇和小龙辩论，因为________________。
Q2	小雅违抗阿娇，因为________________。
Q3	娜娜帮助艳艳，因为________________。
Q4	珍珍激怒婷婷，因为________________。
Q5	诗诗杀阿勇，因为________________。
Q6	小敏喜欢倩倩，因为________________。
Q7	阿伟打动小博，因为________________。
Q8	阿萍同情阿刚，因为________________。
Q9	朵朵惩罚小强，因为________________。
Q10	阿杰尊重小兵，因为________________。
Q11	阿成敬畏雯雯，因为________________。
Q12	静静奖励小杰，因为________________。
Q13	阿霞鄙视小伟，因为________________。
Q14	媛媛激励小婉，因为________________。
Q15	小凯感谢小豪，因为________________。
Q16	阿超珍视小馨，因为________________。
Q17	小峰重视阿雷，因为________________。
Q18	阿涛尊敬阿华，因为________________。
Q19	小刚迎接小雪，因为________________。
Q20	小宇咒骂小茜，因为________________。
Q21	阿浩羞辱小琴，因为________________。
Q22	小坤教育小武，因为________________。
Q23	阿兵可怜小莉，因为________________。
Q24	阿琳了解小兰，因为________________。

Appendix B

Table B1. Database of Chinese Implicit Causality Verbs

Index	Verb	English Verb	SC [a]	EMO [b]	BS [c]	GES [d]
1	抛弃	abandoned	AgPat	Negative	-0.07	0.50
2	厌恶	abhorred	ExpStim	Negative	-0.75	0.00
3	称赞	acclaimed	AgEvo	Positive	-0.73	0.50
4	陪伴	accompanied	AgPat	Positive	0.00	0.33
5	控告	accused	AgEvo	Negative	-0.88	0.00
6	敬佩	admired	ExpStim	Positive	-1.00	0.00
7	影响	affected	StimExp	Neutral	0.71	0.00
8	侮辱	affronted	StimExp	Negative	-0.25	0.60
9	逗笑	amused	StimExp	Positive	0.38	-0.13
10	惹恼	annoyed	StimExp	Negative	0.29	0.50
11	回答	answered	AgPat	Neutral	-0.57	1.33
12	向…道歉	apologized to	AgEvo	Neutral	0.73	0.00
13	为…鼓掌	applauded	AgEvo	Positive	-0.71	0.00
14	感激	appreciated	ExpStim	Positive	-1.00	0.00
15	吸引	attracted	StimExp	Positive	0.71	0.40
16	回避	avoided	AgPat	Negative	-0.07	0.93
17	驱逐	banished	AgPat	Negative	-1.00	0.00
18	相信	believed	ExpStim	Positive	-0.63	0.50
19	背叛	betrayed	AgPat	Negative	0.25	-0.70
20	给…打电话	called	AgPat	Neutral	0.54	0.00
21	释放	captivated	AgPat	Neutral	-0.54	1.00
22	赞扬	celebrated	AgEvo	Positive	-1.00	0.00
23	为…欢呼	cheered	StimExp	Positive	-1.00	0.00
24	安慰	comforted	StimExp	Positive	-0.53	-1.10
25	赞美	commended	AgEvo	Positive	-0.75	0.10
26	赔偿	compensated	AgPat	Positive	1.00	0.00
27	指责	condemned	AgEvo	Negative	-0.87	0.00
28	向…坦白	confessed to	AgPat	Neutral	0.71	0.00
29	使…困惑	confused	StimExp	Negative	0.71	0.00
30	祝贺	congratulated	AgEvo	Positive	-0.88	-0.67
31	咨询	consulted	AgPat	Neutral	-0.69	-1.00
32	讨好	courted	AgPat	Neutral	-0.38	0.53
33	批评	criticized	AgEvo	Negative	-1.00	0.00
34	拥抱	cuddled	AgPat	Positive	-0.09	0.83
35	和…辩论	debated with	AgPat	Neutral	-0.20	0.00
36	欺骗	deceived	AgPat	Negative	0.83	0.00
37	贬低	denigrated	AgEvo	Negative	-0.14	0.83
38	谴责	denounced	AgEvo	Negative	-0.71	0.00
39	嘲笑	derided	AgEvo	Negative	-0.47	0.00

40	憎恶	detested	ExpStim	Negative	-0.82	0.67
41	让…失望	disappointed	StimExp	Negative	0.53	0.40
42	不喜欢	disliked	ExpStim	Negative	-0.83	0.00
43	违抗	disobeyed	AgPat	Negative	-0.13	0.10
44	畏惧	dreaded	ExpStim	Negative	-0.43	0.00
45	雇用	employed	AgPat	Positive	-0.57	0.00
46	鼓励	encouraged	StimExp	Positive	-1.00	0.00
47	启发	enlightened	StimExp	Positive	0.47	-0.83
48	诱惑	enticed	StimExp	Positive	0.08	1.00
49	嫉妒	envied	ExpStim	Negative	-0.69	1.00
50	迷住	fascinated	StimExp	Positive	0.25	0.80
51	害怕	feared	ExpStim	Negative	-0.83	0.67
52	跟随	followed	AgPat	Neutral	-0.33	0.27
53	愚弄	fooled	AgPat	Neutral	0.00	0.33
54	宽恕	forgave	AgEvo	Neutral	-0.07	-0.50
55	忘记	forgot	ExpStim	Negative	-0.56	0.67
56	和…打架	fought	AgPat	Negative	-0.78	-0.67
57	问候	greeted	AgPat	Positive	-0.23	0.00
58	指引	guided	AgPat	Positive	-0.50	0.50
59	骚扰	harassed	StimExp	Negative	0.33	0.67
60	伤害	harmed	AgPat	Negative	0.14	0.67
61	讨厌	hated	ExpStim	Negative	-0.85	0.67
62	帮助	helped	AgPat	Positive	0.17	0.00
63	弄伤	hurt	StimExp	Negative	0.86	0.50
64	鼓舞	inspired	StimExp	Positive	-0.23	0.33
65	打断	interrupted	AgPat	Negative	-0.20	-0.27
66	威胁	intimidated	StimExp	Negative	-0.38	-1.00
67	激怒	irritated	StimExp	Negative	-0.06	0.00
68	杀	killed	AgPat	Negative	-0.14	0.50
69	喜欢	liked	ExpStim	Positive	-0.82	0.00
70	爱	loved	ExpStim	Positive	-1.00	0.00
71	想念	missed	ExpStim	Negative	-0.14	2.00
72	悼念	mourned	ExpStim	Negative	-0.85	0.67
73	打动	moved	StimExp	Neutral	0.43	0.50
74	注意到	noticed	ExpStim	Neutral	-1.00	0.00
75	安抚	pacified	StimExp	Neutral	-0.47	0.67
76	原谅	pardoned	AgEvo	Neutral	-0.41	1.00
77	处罚	penalized	AgEvo	Negative	-0.86	0.00
78	迫害	persecuted	AgEvo	Negative	0.23	1.00
79	同情	pitied	ExpStim	Negative	-0.33	0.00
80	和…玩耍	played with	AgPat	Positive	-0.20	-1.00
81	取悦	pleased	StimExp	Positive	0.29	0.30
82	起诉	prosecuted	AgEvo	Negative	-0.86	0.00

83	保护	protected	AgPat	Positive	-0.47	0.33
84	挑衅	provoked	AgPat	Negative	0.69	0.67
85	惩罚	punished	AgEvo	Negative	-0.69	0.00
86	询问	questioned	AgPat	Neutral	0.00	-0.67
87	补偿	recompensed	AgEvo	Neutral	0.47	-0.50
88	尊重	respected	ExpStim	Positive	-0.54	1.00
89	敬畏	revered	ExpStim	Neutral	-0.85	0.50
90	反抗	revolted	StimExp	Negative	-0.57	1.00
91	奖励	rewarded	AgEvo	Positive	-0.88	0.50
92	向…致敬	saluted	AgEvo	Positive	-1.00	0.00
93	吓唬	scared	StimExp	Negative	0.09	-0.33
94	斥责	scolded	AgEvo	Negative	-0.87	-0.50
95	鄙视	scorned	AgEvo	Negative	-0.54	0.00
96	震惊	shocked	StimExp	Negative	0.63	0.00
97	动摇	shook	StimExp	Neutral	-0.08	0.67
98	冷落	snubbed	AgEvo	Negative	-0.33	0.67
99	凝视	stared at	AgPat	Neutral	-0.29	-0.67
100	激励	stimulated	StimExp	Positive	-0.69	-0.67
101	支持	supported	AgEvo	Positive	-0.78	0.00
102	感谢	thanked	AgEvo	Positive	-0.69	-0.17
103	向…敬酒	toasted	ExpStim	Positive	-0.73	-0.50
104	容忍	tolerated	ExpStim	Negative	0.08	0.00
105	折磨	tormented	StimExp	Negative	-0.14	-0.67
106	珍视	treasured	ExpStim	Positive	-0.83	-0.67
107	信任	trusted	ExpStim	Positive	-0.82	0.67
108	使…心烦	upset	StimExp	Negative	0.85	0.67
109	重视	valued	ExpStim	Positive	-0.83	0.00
110	尊敬	venerated	ExpStim	Neutral	-0.88	0.50
111	污蔑	vilified	AgEvo	Negative	0.54	-0.50
112	拜访	visited	AgPat	Positive	-0.08	-1.00
113	想要	wanted	ExpStim	Neutral	-0.17	0.00
114	警告	warned	AgPat	Negative	-1.00	0.00
115	迎接	welcomed	AgEvo	Positive	-0.73	-1.00
116	让…担心	worried	StimExp	Negative	0.14	0.33
117	担心	worried about	ExpStim	Negative	-0.87	0.50
118	崇拜	worshipped	ExpStim	Positive	-0.88	0.00
119	向…大叫	yelled at	AgPat	Negative	-0.14	0.67
120	质问		AgPat	Negative	-0.69	0.67
121	嘲讽		AgPat	Negative	-0.33	1.50
122	咒骂		AgPat	Negative	-0.09	-0.33
123	推荐		AgPat	Positive	-0.65	0.00
124	逮捕		AgPat	Negative	-0.85	0.00
125	出卖		AgPat	Negative	0.14	0.83

126	同意	AgEvo	Neutral	-0.85	0.00
127	配合	AgPat	Neutral	-0.56	-0.67
128	羞辱	AgPat	Negative	-0.09	0.00
129	欺负	AgPat	Negative	0.07	1.50
130	歧视	AgPat	Negative	-0.23	0.67
131	教育	AgPat	Positive	-0.50	0.67
132	妨碍	AgPat	Negative	0.08	0.50
133	照顾	AgPat	Positive	-0.67	-0.50
134	煽动	AgPat	Negative	0.47	0.00
135	打击	AgPat	Negative	0.07	1.00
136	挽留	AgPat	Positive	0.14	0.50
137	打扰	AgPat	Negative	0.71	0.60
138	恳求	AgPat	Positive	0.45	-1.33
139	培养	AgPat	Positive	-0.50	-1.00
140	误导	AgPat	Negative	0.25	-0.70
141	理解	ExpStim	Positive	0.00	1.50
142	挑逗	AgPat	Negative	0.23	1.00
143	等候	AgPat	Neutral	-0.33	-0.67
144	可怜	ExpStim	Positive	-0.75	0.50
145	联系	AgPat	Neutral	0.23	0.00
146	依靠	ExpStim	Neutral	-0.47	-0.50
147	了解	ExpStim	Neutral	0.33	1.33
148	记得	ExpStim	Neutral	-0.83	0.00
149	仰慕	ExpStim	Positive	-1.00	0.00
150	在乎	ExpStim	Positive	0.08	0.00

a. Semantic Category.

b. Emotion.

c. Bias Score.

d. Gender Effect Score.